

The Vesper-Bells of God

MICHAEL I. PUPIN,
Professor of Science, Columbia University

*Address delivered at Vassar College and reprinted from the
"Catholic Transcript"*

IN my boyhood days I used to spend a part of my school vacation attending to my father's herd of oxen. My schoolmates rendered a similar service to their fathers, and some twelve of us joined our small herds into a large one. The oldest of the boys was the master herdsman and the rest of us were his assistants.

Watching a herd at night is a strenuous art. We had to keep awake at night and watch every step of the grazing oxen, lest they should go astray and be stolen by the cattle thieves who lay in wait in the endless cornfields and watched for their opportunity.

The appetite of the grazing ox is regulated by the hours of the night, and we anxiously watched the progress of the advancing darkness and the gradual approach of the joyful dawn. The blazing stars of the black firmament of the summer night told us, by their position, the hour. I imagined that the light of these stars was a message from God which helped us to guard our grazing herd.

The faint sound of the clock of the distant and slumbering village was another welcome message which, like the message of the stars, aided us in our watchfulness, and thus I gradually began to imagine that the sound of the church bell was also a message from God.

My mother, who was a pious woman, encouraged me in this belief. Whenever the vesper-bell announced that the village priest was about to commence the service my mother would say: "Michael, do you not hear the Divine message which calls you to church to assist the priest in his service at the altar of God?" I listened and obeyed the message.

TWO BOYHOOD QUESTIONS

It is not surprising that in my boyhood days I often put two questions to myself. One question was: What is sound? The other: What is light? A search for an answer to these two questions directed my scientific career. Permit me now to tell you briefly the answer to the first question. This will prepare us for my answer to the second question.

THE VESPER-BELL

When the clapper strikes the church-bell the bell vibrates and transmits its vibrations to the air; the sound waves in the air, spreading out in every direction, reach the listening ear and convey to the inquiring mind of man the following simple story: The collision between the clapper and the bell puts energy into the bell, and, feeding upon this energy, the bell becomes a living thing. Its life manifests itself through its vibrations, which are in harmony with its structure. Neither the clapper nor the power which moves it can change the character of these vibrations. They are the result of the elasticity and the density of the material of which the bell is made, and of its form which the designing intelligence of the bell-maker gave it.

But does that story give us a complete description of this familiar illustration of sound generation, transmission and perception? No, it does not. Most professors of physics stop at this point of the story and say nothing about the message which the bell is conveying to our souls. To get this part of the story we must follow the vibrations in their passage through that marvelous receiving instrument, the ear, which with its 60,000 parts is busy speeding the message along myriads of tiny nerves to the central station, the brain. There the soul of man interprets the language of the bell.

THE MESSAGE TO THE SOUL

This second part of the story of the bell tells me that the vibrating bell is a small link only in the endless chain of physical phenomena which connect the external physi-

cal world to the internal world of our soul, where the message of the bell is deciphered. The more I think about this part of the story of the bell, the more do I recognize today that my boyhood fancy was right when on the pasture lands of my native village I imagined that the faint sound of the distant village clock was a message from God.

I never listen to the melodies of Kreisler's violin without recalling to mind this message of nearly sixty years ago. To me Kreisler's violin is a bell. The smooth and silent movement of his bow communicates to the strings a rapid succession of tiny pulses identical in action to the strokes of the clapper upon the church-bell. They are tiny but numerous clappers. This energy manifests itself in melodious vibrations, carrying a wonderful tale to our listening soul.

The tale is identical with that which I recited to you in my description of the language of the church-bell. But one essential difference must be mentioned. The violin maker, just like the maker of the church-bell, imparts to the bell, called the violin, its fundamental character. The virtues of a Stradivarius are among the glories of human ingenuity. But the temperament and skill of a Kreisler superpose upon this fundamental character of the violin an almost infinite variety of modulation. Kreisler makes the vibrating strings speak a language which is indeed a message from Heaven.

When Kreisler plays Beethoven's sonata he is the apostle of the great composer and delivers his master's message. The message is the embodiment of an inspiration the cradle of which is the soul of the Heaven-born genius. Such a message from Kreisler's violin recalls to memory the vesper-bell of my native village and my mother's words: "Michael, do you not hear God's message which calls you to His altar to praise His everlasting glory?"

This is the answer which science gave me to the question: What is sound?

THE GLORY OF LIGHT

Permit me now to tell you briefly my answer to the second question, What is light? This is, indeed, a momentous question. The sun worship among the ancients

testifies that even without a trace of the scientific knowledge which we possess today the ancients knew intuitively the function of sunlight in all organic life. Without this source of life-giving radiation our terrestrial globe would be a cold and dreary desert.

The greatest glory of science of the nineteenth century is the discovery that light is an electromagnetic phenomenon. To Faraday and to Maxwell and to their native land, the British Isles, belongs that glory. What is the meaning of this wonderful discovery?

It is very simple; indeed it is simplicity itself. A ray of light from our sun or from any hot and luminous body is a swarm of tiny electrical dots and dashes speeding along through space just like the electrical dots and dashes which the wireless telegraph stations send through space, or which the ordinary telegraphers send along wires. Each atom and molecule in the blazing sun is a busy radio station sending messages in all directions. These countless dots and dashes tell us that countless tiny electrical clappers are set in motion by the atoms and molecules of the radiating source.

Now what do I mean by that? Consider what you are doing when you are ringing a telephone-bell. You transmit a rapid succession of electrical pulses along the telephone wire; that is to say, a rapid succession of impulsive electronic motions. The moving electrons are electrical clappers; each of these electronic pulses gives a jerk at the clapper of the telephone-bell, and makes it strike; the bell responds with a ring. The action of the electrical clapper is thus transformed into the action of a material clapper.

PULSES OF THE ATOMS

The dots and dashes coming from busy atoms and molecules of the sun are a rapid succession of electrical pulses; they, like the electrical pulses which ring the telephone-bell, strike the material bodies on earth and communicate to their atoms and molecules the energy of life. Like the bell on the church spire of my native village, or like the melodious strings of Kreisler's violin, these terrestrial aggregations of atoms and molecules respond and radiate vibrations which are in harmony with their struc-

ture. They are the receiving instruments for the messages transmitted by the luminous stars.

In telegraphy we have a code—that is, a certain number of combinations of dots and dashes, each combination standing for a definite word or letter, and the receiving instrument responds equally well to each combination. In a ray of sunlight there are an infinite number of combinations of dots and dashes and it cannot be expected that each terrestrial body will respond equally well to every one of them. We can say that the terrestrial bodies are bells, responding best to some electrical clappers of a definite form.

For instance, this rose responds to an electronic clapper which makes it sing out, "I am red." That rose sings out, "I am yellow," when struck by another type of radiant clapper. The lily responds equally well, singing out, "I am white." St. Luke recorded the words of Jesus who felt the thrill of a true scientist when, beholding the lily, he exclaimed:

"Consider the lilies how they grow; they toil not, neither do they spin; and yet I say unto you that Solomon in all his glory was not arrayed like one of these."

Each tiny flower of the field is a little bell responding to some solar clapper, and so is the brilliant cloud figure which bids good-bye to the setting sun or announces the approach of the early dawn. The whole terrestrial globe is a bell which, responding to the strokes of the solar clappers, glorifies the beauties of our mother earth.

But that is one part only of the message which the sun and the luminous stars are sending to us. Each signaling atom in the sun and in the luminous stars sends us the history of its life and of the life of the star to which it belongs. Listen to a message which the spectroscope reports from a young star somewhere near the very boundary of our stellar system. The message says: "I am a million light years away from you. I am an astral baby now, and will be a baby still when, a million years hence, you receive this message. Many billions of years will pass before the ardor of my youth has cooled down to the moderation of your central star, the sun. Heaven only knows when I shall be as old as your old Mother Earth. But when I reach that age I shall be a beautiful cosmic bell just like your earth and, responding to the

clappers of the luminous stars, I shall add my voice to the celestial choir which is declaring the glory of God."

This is my answer to the question, What is light? The answer recalls to memory the faint strokes of the vesper-bell of my native village of sixty years ago and my mother's voice saying: "Michael, do you not hear the Divine message which calls you to the altar of the Almighty God?"

The Conflict Between Religion and Science

PATRICK J. GANNON, S.J.

This article is reprinted with permission from "Studies" for September, 1926. It was written by the learned Professor of Theology, Milltown Park, Dublin. The article is a commentary on the books listed at the beginning.

Science and Scientists in the Nineteenth Century. By Rev. Robert H. Murray, Litt.D. (Sheldon Press. 1925. 12s. 6d.)

The Everlasting Man. By G. K. Chesterton. (Hodder and Stoughton. 1925. 12s. 6d.)

Science, Religion and Reality. Edited by Joseph Needham. (Sheldon Press. 1925. 12s. 6d.)

The Reminiscences of a Maynooth Professor. By Walter McDonald. (Cape. 1925. 18s.)

Les Confins de la Science et de la Foi. Par l'Abbé Th. Moreux. Deux tomes. (Gaston Doin. 1925-1926. 7 fr. et 10 fr.)

WE hear less nowadays about the conflict between religion and science. This may be partly due to prudential reasons. The consequences of undermining the faith of the millions are with us in such political, social and moral disorders as have startled the prophets of unbelief. The results, above all in Russia, are instructive and have driven serious thinkers back to a reconsideration of many accepted hypotheses. Hence, even if intellectual difficulties continue to exist, they are less paraded before the eyes of the multitude. Such agnosticism as survives has largely lost its aggressive character; and

something of what I may call the Locarno spirit has settled down upon the intellectual as on the political arena.

But this is far from being a complete explanation. There is more than a recoil from practical consequences in the change that has taken place. Even before the Great War signs were not wanting that men in general were growing weary of negation. The mystery of life persisted, nay, was only rendered more bewildering by the growth of knowledge. And it was increasingly realized that certain faculties, aspirations, hopes and fears of humanity were too fundamental to be eradicated; too vast to be satisfied by the mere progress of mechanical invention or the spread of material well-being. *Post equitem sedat atra cura*. It is as true today of the aeronaut as it was of the Roman cavalier in the age of Horace. Man's soul persistently protests against the denial of its existence. There was bound to be a reaction against the materialistic monism of the nineteenth century; and that reaction has now carried us to a stage where a false spiritualism is a greater danger than the materialism which lingers, indeed, in certain quarters, but (to use Mr. Chesterton's words) "as an atmosphere in which men live rather than as a thesis which they defend."

The books indicated at the head of this article afford sufficient basis for an attempt to analyze the tendencies of modern thought on the greatest of all questions. To suppose that they, or many more like them, will decide the issue would be childish sanguine. But they do show that the trend of opinion is distinctly away from the hasty and shallow skepticism of Victorian days. Science, while enlarging enormously its area of conquest, has also become increasingly conscious of the limits of its possible achievements. It has acquired that virtue which is not uncommonly the fruit of experience—humility.

Dr. Murray's work is primarily a history of science and scientific progress in the nineteenth century. It has great human interest as giving us a sidelight into the careers of the men who made that century so remarkable in human progress. But its apologetical value lies in the demonstration that most of these men were too truly scientific to turn into agnostic philosophers. Of one of the few exceptions, Professor Huxley, we are told: "He spawned hypotheses, though he never, as far as we know, originated

a single discovery save the one he made as an undergraduate of nineteen" (p. 318). Dr. Murray himself explains his purpose in the preface:

Some scientists—they are not of the greatest—seem to think that a love of truth actuates a man in their ranks more than anyone else. If one reads such a tenth-rate book as J. W. Draper's *History of the Conflict Between Religion and Science*, or even such a book as A. D. White's *History of the Warfare of Science with Theology in Christendom*, one is conscious that both authors assume unquestioningly that the theologian is moved by prepossessions, whereas the man of science is moved by nothing else than the desire to ascertain the facts as they actually are. Would that it were so with all men of science! . . . I have enough of faith in the candour of men and science to think that if—it is a big if—it is possible to convince them that there are every whit as many prepossessions in their departments as there are in theology, we shall hear less of the warfare between science and theology.

He accomplishes this by showing that there is an *odium scientificum* quite as passionate as the *odium theologicum*, and that it has done more to impede the advance of science than the opposition of the theologians. With almost monotonous regularity all the great discoverers have had to struggle in youth against the neglect and opposition which sprang from the conservatism or jealousy of their fore-runners, only in turn to manifest the same human weakness towards their own successors or supplanters.¹ Of personal expressions of opinion cited the most valuable is perhaps Lister's, made in 1909: "I have no hesitation in saying that, in my opinion, there is no antagonism between the religion of Jesus Christ and any fact scientifically known" (p. 259).

Mr. Chesterton's lively and acute volume is more popular in its appeal and more frankly polemical. He tilts gaily and gallantly against the weird anthropology which assumes our evolution from the ape or beyond. He makes no claim to erudition or research, but voices the plain man's vigorous protest against the pseudo-science which pretends to write the history of pre-historic man; and the equally foolish liberal criticism which seeks in one way or another to diminish the dimensions and thus obscure the transcendence of Christ. The book is full of shrewd thrusts, as for example:

¹Very pathetic is the story of Ignaz Philip Semmelweis of Vienna, who anticipated Lister, but met with such ridicule and opposition that he lost his reason and had to be sent to an asylum (p. 267).

Touching this matter of the origin of religion, the truth is that those who are trying to explain it are trying to explain it away. Subconsciously they feel that it looks less formidable when thus lengthened out into a gradual and almost invisible process. But in fact this perspective entirely falsifies the reality of experience. They bring together two things that are totally different, the stray hints of evolutionary origins and the solid and self-evident block of humanity, and try to shift their standpoint till they see them in a single fore-shortened line. But it is an optical illusion (p. 53).

Practising a self-denying ordinance I will permit myself only one more quotation, in which Liberal criticism of the New Testament is severely but not unjustly handled:

The date of the Fourth Gospel, which at one time was steadily growing later and later, is now steadily growing earlier and earlier, until critics are staggered at the dawning and dreadful possibility that it might be something like what it professes to be. The last limit of an early date for the extinction of true Christianity has probably been found by the latest German professor whose authority is invoked by Dean Inge. This learned scholar says that Pentecost was the occasion of the first founding of an ecclesiastical, dogmatic and despotic Church utterly alien to the simple ideas of Jesus of Nazareth. This may be called, in a popular as well as in a learned sense, the limit. What do professors of this kind imagine that men are made of? . . . Surely anybody's common sense would tell him that enthusiasts, who only meet through their common enthusiasm for a leader whom they loved, would not instantly rush away to establish everything that he hated. No, if the "ecclesiastical and dogmatic system" is as old as Pentecost, it is as old as Christmas. If we trace it back to such very early Christians, we must trace it back to Christ (pp. 250, 251).

Mr. Chesterton is fully cognizant of the currents of thought sweeping over the English-speaking world at least, and he writes as one who feels that the vast, impalpable cloud of doubt, which hung over that world a generation back, is lifting. Or, to change the metaphor, he seems to himself like a cavalry officer called upon to charge a defeated enemy, sullenly retiring and fighting here and there a rearguard action.

But a weightier and more important work is undoubtedly "Science, Religion and Reality," which may be described as a symposium of ten eminent scholars and writers who seek, with admirable impartiality, to examine the question: Are Science and Religion in conflict or in harmony? There is one grave exception to be taken to this volume. The Roman Catholic attitude finds no representative, and the resultant loss is greater than its authors

are aware. But there is also an advantage. Nobody can cast the cheap reproach that fear of Roman anathemas has influenced the opinions expressed.

Earl Balfour's introduction is a piece of exquisite prose, and he puts in almost perfect form, what is for many the most perturbing objection against faith:

It seems clear that such difficulties as there are belong more to the sphere of emotion. They are æsthetic rather than rational; and it is only in some mood of æsthetic sentiment that we can do them justice. Let us then conceive ourselves to be gazing on a clear and quiet night upon the unveiled glory of the heavens, striving to form some adequate representation of the greatness and splendour of the innumerable suns which, crowded though they seem, lie far removed from each other and from us in the unsoundable depths of space. And then, when imagination wearies of the effort, let us consider the petty planet which for the moment is our home, and recall the tremendous events of which in the Christian story it is alleged to have been the scene. Surely in the mood which this experience naturally provokes, the contrast between the conclusions of science and the doctrines of religion, though it may leave our reason unperplexed, must somewhat disturb our feelings.

An American writer has described this sense of human insignificance amid the vastness of the universe as the "cosmic chill." Earl Balfour answers it by the latest teaching of science as to the nature of celestial bodies:

The glory of the stars is the joint product of our mental constitution, our nervous system, our eyes and certain electro-magnetic happenings whose effects are conveyed to us from the remotest parts of space through the ether by which we are surrounded. The orbs of heaven, apart from our perception of them, consist of incredibly minute electric charges thinly scattered through the vast and vacant areas, which, in the language of sense perception, we describe as stars. . . . It is to us who dwell on earth that these glories owe their being. If we are nothing, they are nothing. They are born of our terrestrial sensibilities.

Perhaps a simpler answer is that mind and matter are incommensurable quantities, and that the simplest spiritual being transcends in dignity and importance a thousand suns and solar systems. The spectacular immensity of the universe creates a difficulty for the imagination, but not for the intellect. Men in general are too much under the domination of the imagination. But the philosopher should control the operation of this important but deceptive faculty. It is the function of the intelligence, Kant

tells us, to set limits to the imagination's play of fancy (Schwärmerei). It is difficult to *imagine* so vast a world pivoting on so poor a thing as man appears to be. Yet if man is the only creature of intellect and will within the confines of the cosmos—a question we cannot settle with certainty—the cosmos exists that he, seeing it, may glorify God. For the glory of God is the end of creation; and only reasonable beings can give formal glory to God. All this may seem scholastic or medieval to modern thought. But let the latter supply an acceptable substitute before it asks us to abandon the only explanation which gives a meaning to any single thing within our ken.

Now that we are spiritual beings, that there is something in us which cannot be explained in terms of matter, whatever be the ultimate analysis which science offers of matter, is generally admitted today. As Earl Balfour well says, "no man really supposes that he personally is nothing more than a changing group of electrical charges, so distributed that their relative motions enable or compel them in their collective capacity to will, to hope, to love, to think, perhaps to discuss themselves as a physical unity." And spiritual reality once admitted, the laws governing it are immediately and obviously removed from the empire or inquisition of the physical sciences. Hence the possibility of conflict is excluded, and such opposition as appears to exist necessarily springs from exaggerated statements or claims on one side or the other. The fact that misunderstandings between science and religion have at times arisen in the past is too obvious to be denied. But the whole drift of this volume is to show that there have been misunderstandings and no more. The blame for them has lain now with the theologian, now with the scientist; but the number and the extent of them have also been exaggerated.

Dr. Charles Singer in a paper entitled "Historical Relations" seeks to specify the times and circumstances in which opposition, real or apparent, arose between the two great departments of human knowledge. He does not find such opposition among primitive men, to whom indeed he attributes too little of either science or religion.

Neither does he discover it in the early civilizations of Egypt or the Mesopotamian peoples, nor yet among the Jews. For him the true idea of science, as we understand

it now, arose among the Greeks; and it was first clearly differentiated from religion by the Coan physician, Hippocrates the Great. The philosophers trenched upon both domains, and might (he thinks) have come into conflict with religious teaching if there had been any serious religious system; but there was not. Curiously enough he sees in Wisdom, ch. v, a Jewish repudiation of Greek thought, and in the Apocalyptic literature of the Rabbis, as well as the early Christian insistence upon the Day of the Lord, he detects a revolt against the study of phenomena, which is science. Galen of Pergamum (150-200 A. D.) took up intermediate ground between Stoicism and Christianity, and with his death "science too fell dead and was not reborn for a thousand years."

The early Christian Church was in opposition to the philosophical basis of pagan thought, and so far forth in opposition to the deterministic science imbedded in it. "But the conflict was simply with a philosophical tradition which contained dead, non-progressive, and misunderstood scientific elements." In the Middle Ages Christianity and Aristotelianism worked harmoniously, though Dr. Singer thinks the harmony was conditioned to a large extent by medieval ignorance of the real teaching of Aristotle. Such conflict as arose "was not of faith *versus* observation, but of opinion *versus* opinion." Indeed the Ptolemaic system, coupled with the general philosophic outlook of the time, rendered conflict impossible. There were no discoveries of natural laws, no proclamation of scientific theories based upon detailed observation, experiment, and research to clash with received beliefs. The birth of modern science falls between 1500 and 1700 A. D. Here we find the beginning of misunderstandings. Even then "it was the cosmical speculations of astronomers and physicists, not the investigations of biologists, that attracted unwelcome ecclesiastical attention." Dr. Singer tells the story with a laudable effort at impartiality. Thus he writes: "Giordano Bruno (1548-1600), who was no practical scientist, had eagerly incorporated into his often fantastic philosophy the ill-worked-out conclusions of Copernicus. Despite the allegorical presentation of his thoughts, his works leave us in no doubt of the vehemence of his attack upon established religion." In his account of the famous Galileo controversy he exaggerates the part played by the Jesuits

in opposition to the great scientist, who had friends as well as adversaries in the Order. Bellarmine was distinctly friendly, though he seems to have thought the doctrines dangerous and wrong. It was a Dominican who first brought Galileo's teaching under the notice of the Inquisition, and the theological opposition was too general to be laid at the door of any particular group. The new ideas were startling, and it is to be noted that Galileo brought very inadequate scientific proofs, while his efforts to wrest the Scriptures to his views were not felicitous. But Dr. Singer, at least, spares us all the nonsense about torture and persecution which has been current ever since in non-Catholic circles. Of Kepler, who carried on the work of Galileo, he writes: "Kepler, despite the mystical and doubtless heretical tendencies of many of his religious views, retained a perfectly simple religious faith, and regarded scientific discovery as a process of the revelation of the greatness of the Creator." Again neither Descartes nor Newton were at loggerheads with religion. The errors of the former both in philosophy and science were soon manifest enough. But they were debated without any particular *odium theologicum*, and were refuted by scientists and philosophers more than by theologians. In conclusion Dr. Singer thinks that the real achievement of science which may be supposed to constitute a difficulty for religion is the discovery of the reign of law. Even Darwinism has introduced no new factor. "After Darwin it was neither easier nor harder to explain how man could escape from the tyranny of natural law. Darwin doubtless brought the problem home to the ordinary man; he did not create it for the thinker."

Yet we may ask ourselves: Does it exist for the thinker at all? The Reign of Law may be taken to mean the existence of an ordered universe governed by a Supreme Lawgiver, and then no difficulty is created for any thinker who has an elementary grasp of logic; or it may mean, as on the lips of many it apparently does mean, the existence of an uncaused, unexplained universe subject to laws emanating from no lawgiver, governed by no purpose and moving to no end. Such a conception certainly conflicts with religion; but does it not also conflict with the primary laws of thought? And if any scientist asserts such a metaphysical system, is he not quitting his last very

foolishly and erring very palpably? Dr. Singer is able to assure us that the majority of men of science "have accepted their religion as they found it. . . . A proportion of scientific men, incensed by the mere discrepancy between the Biblical and the scientific record, have abandoned more or less completely their relation to religion." He himself seems to suppose there are only two ways out—a separation of internal from external experience and a flight to a haven of peace down the mystic way, or a combination of determinism and pantheism such as has appealed to many scientists since Spinoza. But is there not a *tertium quid*, namely, a synthesis of internal and external experience, leading through reason to a higher unity and a First Source of spirit and matter as well as of laws governing both realms? Nothing is more astonishing than the assumption that religion needs a lawlessness in the universe either for its existence or for its demonstration. On the contrary, one of the metaphysical arguments for the existence of God is based precisely on the awe-inspiring manifestation of wisdom in the ordering of the cosmos. The Book of Wisdom and St. Paul argued from it; and the pre-Copernican scholastics argued from it with no less fervor than the post-Copernicans. Every increment to our knowledge of that order reinforces this impressive argument.

Neither does free-will clash with the reign of law. It certainly clashes with a purely mechanical, deterministic interpretation of life. But does this not also clash with one of the evident data of consciousness—our own freedom? Professor Needham in his own able contribution concludes:

I have hoped also to show that although mechanism in biology is perfectly justified, and indeed essential, it cannot be applied to psychology. . . . The earlier mechanistic biology, before the era of experimental science, was indeed somewhat incompatible with religion, because it did not know its own limitations, nor did these become apparent until quite recent times. But now that the assumptions on which the triumph of mechanistic biology in the last century is based have been well examined, it is seen that for its own sphere it is a real triumph, but, at the same time, its jurisdiction over other fields cannot be admitted.

The theologian is not called upon to take sides in the purely biological discussion. But if mechanism is ex-

cluded from psychology, he has all he needs for maintaining the freedom of the soul.

And here it is interesting to observe a certain ironical *revanche de Dieu*, which has its pathetic as well as its instructive aspects. "The Reminiscences of a Maynooth Professor" appeared simultaneously with the volume under consideration. In this retrospect of a troubled career, Dr. McDonald retells the story of his work, "On Motion," with an unshaken assurance that the thesis condemned by Church authority was and is true, was and is alone compatible with science. Let us see. Dr. McDonald assumes as a conclusion of science that all energy is kinetic. From this he goes on to argue that all causation in secondary causes is motion received from the First Cause and passed on. He then extends this to spiritual activities, and bases on it a novel theory of the Divine concursus, natural and supernatural. We need not here enter into this highly metaphysical question. It will be enough to examine the starting point of the discussion. Is all energy kinetic? It is true that many scientists thought so half a century ago. But now Professor Aliotta of the University of Naples, in a paper entitled "Science and Religion in the Nineteenth Century," informs us that "Carnot's principle shows the impossibility of reducing all the varied forms of energy to kinetic alone." Hence, even in the domain of physical forces, the hypothesis that led a professor of theology to views on spiritual agencies which seem to jeopardize the freedom of the will has been disproven by experiments in thermodynamics! This is only one example of what has often occurred, namely, the appearance of conflict arising from the too hasty acceptance of scientific hypotheses and the extension of them to fields where, whether true or false, they do not apply. If Dr. McDonald had brought to the consideration of scientific teaching as critical a spirit as he manifested in his study of theology, he might have been spared much spiritual anguish. Professor Aliotta adds: "The law of the conservation of quantity has no significance in the spiritual life, but is rather a perennial creation of new qualities." And again: "Some of the foregoing observations have shown us that there was a profound contradiction in the very bosom of the theory of evolution, which was the pet idea of Positivism."

Professor Needham in another place writes:

The triumph of mechanistic biology has indeed been a real one, for it has succeeded in abolishing the vital force in living things which so unnecessarily complicated the whole question. We are back again with the concept of the undivided anima, and the ground is perfectly clear for philosophical and psychological discussion as to the psychophysical problem.

This looks very like a confirmation of that Canon of the Council of Vienne which Dr. McDonald held would need revision, namely, that "the rational or intellectual soul is essentially and *per se* the form of the body." Needless to say I pass no judgment on the biological problem. Much in the Professor's paper supposes a specialized knowledge which I am far from possessing. But I may again point out the ironical contrast between Dr. McDonald's abandonment of an infallible statement and the most recent confirmation of that statement by biologists, not theologians.

Professor Eddington in his contribution, "The Domain of Physical Science," sums up the present situation thus:

We have attempted in this essay to show the direction which, it appears to us, the tendency of modern scientific thought is taking. It differs markedly from the views of thirty years ago. . . . Let the scientist stick to his pointer-readings, is a good rule; and if, like many before us who have broken it, we have lost our way in the outer fog, we may perhaps plead that it was necessary to show that students of the nineteenth and twentieth centuries have at least different ways of losing themselves, and the unqualified materialism of the last century is not today the most inviting by-path. Our thesis has been that the recent tendencies of scientific thought lead to the belief that mind is a greater instrument than was formerly recognised in prescribing the nature and laws of the external world as studied in physical science; that in exploring his own territory the physicist comes up against the influence of that wider reality which he cannot altogether shut out. . . . We have spelt mind with a small "m," for our values are human values; yet we trust there is in us something that has value for the eternal. Perhaps the activity of the world is not only in these little sparks from the divine mind which flicker for a few years and are gone, but in the Mind, the Logos. "The same was in the beginning with God. . . . And without Him was not anything made that was made." It will not be expected that science should indicate how this colourless pantheism is to be made into a vital religion. Science does not indicate whether the world spirit is good or evil, but it does perhaps justify us in applying the adjective "creative." It is for other considerations to examine the daring hypothesis that the Spirit in whom we have our being—our

actuality—is approachable to us; that He is to us the beneficent Father, without which it seems to me, the question of the theoretical existence of a God has little significance.

This is not a very precise or triumphant credo; but it is all the more typical of the work we are examining on that account. All the writers are clear about the dualism of mind and matter. All admit that science keeping to its own province cannot pronounce on origins or ultimate causes. All deny that the sciences invalidate the claims of religion. All agree that the laboratory cannot settle everything. They are conscious that physics, however developed, do not render metaphysics superfluous. Thus far their papers have apologetical value. But it must be admitted that their own philosophical and religious ideas are neither clear nor accurate. Even Professor Oman, in a conscientious effort to define religion, arrives at a definition which is inadequate rather than erroneous. But he registers one very useful protest:

Religion, more than any other subject, claims interest as its due, and more definitely affirms that it cannot be found or understood without something like enthusiasm for it. . . . But this view is far from receiving universal acceptance. While students of other subjects are approved for regarding their facts as certain and important, interest in religion is frequently forthwith and without further discrimination identified with bias. Thus, not only a complete lack of interest, but a positive distaste for the whole business has at times been put forward as a necessary qualification for an uncorrupted inquiry. Lack of interest in a subject which deserves interest is itself bias, and is sure to overlook or distort the facts to be considered.

Dean Inge in his "Conclusion," while agreeing with the tenor of what the scientists had said, adds the warning: "Those Churchmen who airily declare that there is no longer any conflict between Christianity and science are very thoughtless or are wilfully shutting their eyes. There is a very serious conflict, and the challenge was presented not in the age of Darwin, but in the age of Copernicus and Galileo." His difficulty is, however, very different from the one mentioned by Earl Balfour. He thinks that the creeds of the Church suppose geocentrism so essentially that they are rendered meaningless by the Copernican astronomy. Of all the difficulties touched on in the volume this seems the strangest. The dullest medi-

eval theologian or philosopher would have smiled at the idea that the dogmas of the Resurrection and Ascension, of Hell and Heaven could be essentially dependent on our ideas of space and time. No doubt there was, is, and must be a certain anthropomorphism in our formulation of Divine truths. Yet surely an Aquinas or a Scotus saw that too clearly to be deceived by the form of the expression. That the dogmas of the faith were irrevocably bound up with "a geographical heaven" such as is found in the Ptolemaic system would have seemed to them just puerile.

It is a relief to pass from this work, sincere and reverent though it be, to the two volumes in which Abbé Moreux makes a comprehensive survey of the whole question. It is a relief for the reason that both sides of the case are so clearly stated. He begins by assuring us that "if we follow him we shall discover that the confines of religion and science are much more restricted than is generally thought." The dogmas of Faith which come under consideration are: "An eternal God, Creator of the world, which He has drawn from nothingness and governs by laws freely chosen by Himself, which do not exclude miracle or prayer. God, finally, creating man in His Image, that is, giving him a spiritual soul endowed with intelligence and free-will." Does science contradict any one of these? The learned Abbé (and the adjective is here no *epitheton ornans*) gives a very decisive negative. He shows, first, that science, unlike dogma, is perpetually changing, advancing from hypothesis to hypothesis. Of these some are later demonstrably falsified; the best suffer very profound modifications. He does not deny to scientists the right to form hypotheses, without which there would be no advance at all, nor even the right to call in the aid of philosophy and metaphysics. Only he pleads that they shall first acquire some grasp of philosophy, especially of the fundamental branch called Logic, that is the laws of right reason, and of the basic truths of metaphysics. But the agnostic scientists, while pretending to deride philosophy and metaphysics, are perpetually making statements that are not the offspring of scientific investigation, but the fruits of mental bias. Littré declared: "The essential postulate of materialism is the eternity of matter, namely, that it has had no origin and shall have no end." This and the infinity of space are,

according to Abbé Moreux, the fundamental dogmas of positivism. Both are, he contends, demonstrably false. The world we behold, though unimaginably vast, cannot be infinite and cannot be eternal. Science affords no basis for eternal evolution. On the contrary, the phenomenon of entropy or transformation of energy shows that the cosmos, if existing from eternity, would be like a clock run down. And to suppose a winding up again without some extracosmic power would be, first, a gratuitous supposition and, secondly, an absurd one. The value of these volumes, however, lies rather in the proofs they give how the recent discoveries of science have made the older materialistic hypotheses appear rather ludicrous.

On the whole, then, we may conclude that science today creates less difficulties for faith than ever. It has altered none of the facts upon which metaphysics based its proofs of God's existence, attributes and activities. It has in no wise disproved a *causa finalis* or weakened the force of the teleological argument. It has utterly failed to explain mind as a function of matter. It has not and cannot disprove the possibility of miracle. It leaves the problem of belief where it was from the beginning, and where it shall be to the end.²

²Since these pages were written a very interesting discussion on the same subject has taken place in France. M. Robert de Flers of the French Academy addressed to all living members of the Academy of Sciences the following query: *La Science est-elle opposée au sentiment religieux?* The answers were published in the *Paris Figaro* (May 2-22, 1926), and Père de Grandmaison, S.J., has made them the subject of an article in *Etudes* (July 5th), which concludes thus: "One will not be far wrong in summing up the inquiry conducted by *Figaro* by saying that all the present members of the Academy of Sciences have declared themselves against the opposition, so long hinted at and even actually taught in a number of scholarly works, between science and religion. This pretended antagonism is indefensible; not a voice was raised in its favor. . . . The great majority of these scholars went much farther, and concluded to a positive compatibility."

The Church and Science

DR. JAMES J. WALSH

Reprinted from the "American Ecclesiastical Review"

IN Poggendorf's "Biographical Dictionary of the Exact Sciences," which is accepted as authoritative, there are in the first two volumes the names of nearly 10,000 contributors to science from the beginning of human history until 1863. This list embraces some twenty-five centuries. No inconsiderable proportion of these, as I have said in the introduction to the second volume of "Catholic Churchmen in Science," lived before Christianity. In spite of this, a little more than ten per cent. of all the names in this work are those of Catholic clergymen, that is to say, nearly 1,000 Catholic clergymen before 1863 had done work that gives them an enduring name in the history of science. . . . In spite of the presumed probability of any considerable number of those outside scientific circles securing a place in the litany of scientists, more than one in ten of all the men distinguished for original investigation in science is a Catholic clergyman. This can only mean that a very large number of the churchmen of all periods occupied themselves with things scientific in the leisure afforded them by their clerical vocation, and that nearly 1,000 of them reached noteworthy distinction in their avocation. This number is magnificently significant of the attitude of the Church towards science. It is perfectly clear that there can have been no policy of opposition to science or scientific research and investigation under these circumstances. Some incidents of opposition to scientific development are inevitable in the history of the Church and science, because men are prone to be conservative, as I have said, and refuse to accept new ideas and find all sorts of excuses, some of them religious, for not accepting them. Manifestly, however, the policy of the Church was very favorable towards science, since so many of the ecclesiastics took up science as a favorite avocation and devoted themselves to it so faithfully that they accomplished results which have left their names forever famous in the history of science.